Appendix A

Sampling and Analysis Plan

1.0 Introduction

This appendix presents the field and sampling procedures and the analytical testing program that will be used to complete the field and analytical work for this project. Quality assurance and quality control (QA/QC) procedures are also discussed in this appendix.

2.0 Field and Sampling Procedures

The scope of work (SOW) includes stormwater sampling and chemical analysis. The field and sampling procedures include collection of grab and composite stormwater samples, sample management (i.e., containers, storage, and shipment), decontamination procedures, and handling of investigation-derived wastes (IDW).

2.1 Preparatory Activities

Site Health and Safety Plan. A Site-specific health and safety plan (HASP) will be prepared for the proposed activities in general accordance with the Occupational Safety and Health Act (OSHA) and the Oregon Administrative Rules (OAR). A copy of the HASP will be maintained on-site during the field activities.

2.2 Collection of Grab Stormwater Samples

To determine what additional Source Control Measures (SCMs) may be effective, the Port needs to understand what area(s) are potentially contributing higher relative contaminant concentrations. Inline grab samples will be collected from selected upstream access points (i.e., manholes and cleanouts) with concurrent composite sampling at the basin discharge. The composite sampler will record the total flow measurement at the outfall sampling location (see Section 2.3).

The unfiltered grab samples will be obtained in accordance with Standard Operating Procedure (SOP) 2.12. A telescoping swing sampler with a pre-cleaned stainless steel cup will be used to collect the water samples. The only exception is at location CO-1 (cleanout; see Figure 8 of Work Plan) where the necessary sample volume will be obtained using a peristaltic pump. The inlet tube will be weighted in order to keep the tubing in the flow. The water samples will be transferred into 1-gallon laboratory-decontaminated bulk sample containers for transport to the laboratory. The laboratory will transfer the samples into the respective sample containers for each analysis.

Field parameters will be measured in order to estimate the flow volume during sampling. These parameters include the depth of the flow (to be collected using water sensing paste on a measuring tape) and flow velocity (to be collected using a digital flow meter).

2.3 Collection of Composite Stormwater Samples

Bulk storm water samples will be collected as composite samples, which comprise a number of discrete individual samples of specific volumes taken at flow-weighted intervals (i.e., more discrete samples are collected during higher flow volumes). The composite sample will be completed in accordance with Standard Operating Procedure T4-Composite. An automatic composite sampler will be set up with an area velocity flow meter that activates the sampling when the target flow depth and rate are achieved. The stormwater samplers will be installed in relatively low-traffic areas and consequently the samplers will likely be installed above ground (and covered with large wood boxes).

The samplers will be programmed to fill individual 1-gallon bottles one at a time (i.e., sample aliquots are collected in each 1-gallon vessel until it is full). Filling of the first bottle will commence when the target flow is reached. Once each bottle is filled the sampler will move to the next empty bottle. The collected stormwater from the four 1-gallon bottles will be composited and samples for chemical analysis will be collected from that composite. The stormwater samples will be obtained from the same manhole where sampling was historically conducted.

Reporting will include an analysis of the collected flow data and event rainfall hydrographs to indicate the duration of the storm sampled and whether first flush and peak flow were captured during sampling.

2.4 Sample Management

Containers. Clean sample containers will be provided by the analytical laboratory ready for sample collection.

Labeling Requirements. A sample label will be affixed to each sample container before sample collection. Containers will be marked with the project number, a sample number, date of collection, and the sampler's initials.

Sample Storage and Shipment. Sample will be stored in a cooler chilled with ice or blue ice to 4 degrees Celsius (°C). The cooler lid will be sealed with chain-of-custody seals. If necessary, the samples will be sent via overnight courier to the analytical laboratory for chemical analysis. Otherwise, Apex Companies, LLC (Apex; formerly Ash Creek Associates) will transport the containers to the laboratory. Chain of custody will be maintained and documented at all times.

2.5 Decontamination Procedures

Personnel Decontamination. Personnel decontamination procedures depend on the level of protection specified for a given activity. The HASP will identify the appropriate level of protection for the type of work and expected field conditions associated with this project. In general, clothing and other protective equipment can be removed from the investigation area. Field personnel should thoroughly wash their hands and faces at the end of each day and before taking any work breaks.

Sampling Equipment Decontamination. To prevent cross-contamination between sampling events, clean, dedicated sampling equipment will be used when possible for each sampling event and will be discarded after use. Cleaning of non-disposable items will consist of washing in a detergent (Alconox®) solution, rinsing with tap water, followed by a deionized (DI) water rinse.

2.6 Handling of Investigation-Derived Waste

Disposable items, such as sample tubing, gloves, protective overalls (e.g., Tyvek®), paper towels, etc., will be placed in plastic bags after use and deposited in trash receptacles for disposal.

3.0 Analytical Testing Program

An analytical testing program will be performed to assess the chemical quality of samples collected as part of this project. Analytical laboratory QA/QC procedures are discussed in Section 4 of this appendix.

The laboratory-supplied method reporting limits (MRLs) and method detection limits (MDLs) are presented in Table B-1 along with the JSCS screening levels (DEQ/EPA, 2005). Samples will be collected and handled using methods described in Section 2 of this appendix.

The contaminants of interest (COI) and respective analytical methods that are anticipated for this project include:

- Total polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270-SIM;
- Total arsenic by EPA Method 1632; and
- Total suspended solids (TSS) by SM 2540D.

4.0 Quality Assurance Program

4.1 Quality Assurance Objectives for Data Management

The general QA objectives for this project are to develop and implement procedures for obtaining and evaluating data of a specified quality that can be used to assess the concentrations of PAHs, arsenic, and TSS. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples collected must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain-of-custody procedures (see Section 4.3).

MDLs and analytical results will be compared to action levels for each parameter in media of concern. The detection limits listed in Table B-1 are the expected MDLs and MRLs, based upon laboratory calculations and experience.

Specific QA objectives are as follows:

- Establish sampling techniques that will produce analytical data representative of the media (e.g., stormwater) being measured.
- Analyze a sufficient number of analytical duplicate samples to assess the performance of the analytical laboratory.
- Collect and analyze a sufficient number of blank samples to evaluate the potential for contamination from sampling equipment and techniques, and/or transportation.
- Analyze a sufficient number of blank, standard, duplicate, spiked, and check samples within the laboratory to evaluate results against numerical QA goals established for precision and accuracy.

Precision, accuracy, representativeness, completeness, and comparability parameters used to indicate data quality are defined below.

4.1.1 Precision

Precision is a measure of the reproducibility of data under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. For duplicate measurements, precision can be expressed as the relative percent difference (RPD). Field duplicates will not be collected. A 5-percent duplicate frequency will be carried out for laboratory samples.

4.1.2 Accuracy

Accuracy is the measure of error between the reported test results and the true sample concentration. True sample concentration is never known due to analytical limitations and error. Consequently, accuracy is inferred from the recovery data from spiked samples.

Because of difficulties with spiking samples in the field, the laboratory will spike samples. The laboratory shall perform sufficient spike samples of a similar matrix to allow the computation of the accuracy. For analyses of less than five samples, matrix spikes may be performed on a batch basis.

Perfect accuracy is 100 percent recovery.

4.1.3 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration of the chemical parameters in the medium sampled. Sampling procedures—as well as sample-handling protocols for storage, preservation, and transportation—are designed to preserve the representativeness of the samples collected. Proper documentation will confirm that protocols are followed. This helps to assure sample identification and integrity.

Laboratory method blanks will be run in accordance with established laboratory protocols to ensure samples are not contaminated during sample preparation in the laboratory.

4.1.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid. The completeness goal is essentially that a sufficient amount of valid data be generated to meet the closure requirements.

4.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The objective of this QA program is to assure that all data developed during the investigation are comparable. Comparability of the data will be assured by using EPA-defined procedures which specify sample collection, handling, and analytical methods. The comparability of past data will be evaluated during the investigation (if possible) by assessing the techniques used for sample collection and analysis.

4.1.6 Documentation

Essentially, EPA Level III documentation will be generated during this investigation. This level of documentation is generally considered legally defensible and consists of the following:

- Holding times
- Trip blank data
- Field duplicate data
- Rinse blank data
- Laboratory method blank data
- Sample data
- Matrix/surrogate spike data
- Duplicate sample data

4.2 Sampling Procedures

Sampling procedures for stormwater are presented above in Section 2 of this appendix. These procedures are designed to ensure:

- Samples collected at the site are consistent with project objectives; and
- Samples are identified, handled, and transported in a manner that does not alter the representativeness of the data from the actual site conditions.

QA objectives for sample collection will be accomplished through a combination of the following items:

- **Trip Blank.** No trip blanks are planned for the stormwater sampling program as there are no planned analyses for volatile organic compounds (VOCs).
- **Rinse Blank Sample.** No rinse blanks are planned for the stormwater sampling program as there will be dedicated tubing and laboratory-supplied containers.
- **Duplicate Samples.** No field duplicates are planned for the stormwater sampling program.
- **Laboratory QA.** Laboratory duplicate measurements will be carried out on at least 10 percent of laboratory samples. Analytical procedures will be evaluated using the protocols of the analytical laboratory. These protocols can be submitted upon request.

4.3 Sample and Document Custody Procedures

The various methods used to document field sample collection and laboratory operation are presented below.

4.3.1 Field Chain-of-Custody Procedures

Sample chain-of-custody refers to the process of tracking the possession of a sample from the time it is collected in the field through the laboratory analysis. A sample is considered to be under a person's custody if it is:

- In a person's physical possession;
- In view of the person after possession has been taken; or
- Secured by that person so no one can tamper with the sample, or secured by that person in an area restricted to authorized personnel.

A chain-of-custody form is used to record possession of a sample and to document analyses requested. Each time the sample bottles or samples are transferred between individuals, both the sender and receiver sign and date the chain-of-custody form. When a sample shipment is transported to the laboratory, a copy of the chain-of-custody form is included in the transport container (e.g., ice chest).

The chain-of-custody forms are used to record the following information:

- Sample identification number
- Sample collector's signature
- Date and time of collection
- Description of sample
- Analyses requested
- Shipper's name and address
- Receiver's name and address
- Signatures of persons involved in chain of custody

4.3.2 Laboratory Operations

The analytical laboratory has a system in place for documenting the following laboratory information:

- Calibration procedures
- Analytical procedures
- Computational procedures
- Quality control procedures
- Bench data
- Operating procedures or any changes to these procedures
- Laboratory notebook policy

Laboratory chain-of-custody procedures provide the following:

- Identification of the responsible party (sample custodian) authorized to sign for incoming field samples and a log consisting of sequential lab tracking numbers.
- Specification of laboratory sample custody procedures for sample handling, storage, and internal distribution for analysis.

4.3.3 Corrections to Documentation

Original data are recorded in field notes and on chain-of-custody forms using indelible ink. Documents will be retained even if they are illegible or contain inaccuracies that require correction.

If an error is made on a document, the individual making the entry will correct the document by crossing a line through the error, entering the correct information, and initialing and dating the correction. Any subsequent error discovered on a document is corrected, initialed, and dated by the person who made the entry.

4.4 Equipment Calibration Procedures and Frequency

Instruments and equipment used during this project will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by laboratory personnel fully trained in these procedures.

4.5 Analytical Procedures

Samples will be analyzed using essentially SW 846 analytical protocols for the parameters identified above in Section 2 of this appendix.

4.6 Data Reduction, Validation, and Reporting

Reports generated in the field and laboratory will be included as an appendix to the draft and final versions of the Data Summary Report.

The task manager will assure validation of the analytical data. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and QA/QC data to enable the reviewer to determine the quality of the data. Validity of the laboratory data will be determined based on the objectives outlined in Section 4.1 - Quality Assurance Objectives for Data Management. Data validity will also be determined based upon the sampling procedures and documentation outlined in Sections 4.2 and 4.3 of this Sampling and Analysis Plan (SAP). Upon completion of the review, the task manager will be responsible for assuring development of a QA/QC report on the analytical data. Data will be stored and maintained according to the standard procedures of the laboratory. The method of data reduction will be described in the final report.

4.7 Performance Audits

Performance audits are an integral part of an analytical laboratory's SOPs and are available upon request.

4.8 Corrective Actions

If the QC audit detects unacceptable conditions or data, the project manager will be responsible for developing and initiating corrective action. The task manager will be notified if the nonconformance is significant or requires special expertise. Corrective action may include the following:

- Reanalyzing the samples, if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging level of uncertainty or inaccuracy by flagging the data.

4.9 Quality Assurance Reports

The task manager will prepare a QA/QC evaluation of the data collected during the Site investigation field activities for inclusion in the final report. In addition to an opinion regarding the validity of the data, the QA/QC evaluation will address the following:

- Any adverse conditions or deviations from this SAP.
- Assessment of analytical data for precision, accuracy, and completeness.
- Significant QA problems and recommended solutions.
- Corrective actions taken for any problems previously identified.

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes the methods used for obtaining automated composite water samples from storm drains, outfalls, flumes or surface waters for physical and/or chemical analysis. This SOP does not include collection of grab samples.

Bulk storm water samples will be collected as composite samples, which comprise a number of discrete individual samples of specific volumes taken at flow-weighted intervals (i.e., more discrete samples are collected during higher flow volumes). An automatic composite sampler will be set up with an area velocity flow meter that activates the sampling when there is flow in the pipe. The objective is to get a composite sample that represents the water quality over the longest practicable storm hydrograph. This procedure is applicable during Apex Companies, LLC (Apex) automated composite water sampling activities at Terminal 4.

2. EQUIPMENT AND MATERIALS

The following materials are necessary for this procedure:

- Automated sampler (Teledyne-Isco Model 6712 or similar) equipped with four pre-cleaned 1-gallon glass collection vessels, a Teflon® screen, a Teflon® sampling tube, and an area/velocity (AV) type flow meter.
- RV/marine deep cycle 12 volt batteries.
- Stainless steel mounting brackets for flow sensor and sampling tube
- Wooden sampler cover (where necessary – varies by site)
- Mounting hardware to hang sampler in manhole (where necessary – varies by site)
- Field documentation materials (including flashlight)
- Decontamination materials
- Personal protective equipment (as required by Health and Safety Plan)

3. METHODOLOGY

Project-specific requirements will generally dictate the preferred type of sampling equipment used at a particular site. The following parameters should be considered: accessibility of sampling point, sampling depth, and flow rate. Analytical testing requirements will indicate sample volume requirements that also will influence the selection of the appropriate type of sampling method. The project sampling plan should define the specific requirements for collection of outfall water samples at a particular site.

<u>Installation and Maintenance of Sampler</u>

- Program each sampler with the flow velocity for that specific pipe corresponding to the target rainfall event intensity. The Rational Method, in combination with Manning's equation and pipe geometry will be used to estimate flow velocity for the initial flow-weighting programming for the composite samplers. The Rational Method is a widely used method for estimating runoff of small drainage basins.[1] The Manning equation[2] and pipe geometry will be used to estimate the flow level and velocity expected in

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[1] The rational method equation is: Q = kCiA where: Q – runoff flow; k – conversion constant; C - dimensionless runoff coefficient; i - rainfall intensity and A - catchment area.

[2] The Manning Equation was developed for uniform steady state flow in an open channel and is: $V = \frac{k}{n} R_h^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$ where:

V is the cross-sectional average velocity; *k* is a conversion constant *n* is the Manning coefficient of roughness; R_h is the hydraulic radius; *S* is the slope of the water surface. The discharge formula, $Q = AV$, can be used to manipulate Manning's equation to compute flow knowing limiting or actual flow velocity.

the storm water conveyance system within each basin based on the estimated runoff from a criteria storm.

- Program each sampler with the pipe diameter and the length of the suction sample line. Pre-program multiple sampling routines that include different proportional volume sampling rates so that an appropriate program can be selected based on the predicted magnitude of the storm. The sampling routines will be further modified for each storm based on the magnitude of the predicted storm, site-specific rainfall hydrographs/hyetographs, and measured flow data collected during sampling events. The objective is to get a composite sample that represents the water quality over the longest practicable storm hydrograph. Ideally sampling will be completed over the entire duration of the storm event. At a minimum, sampling will occur for at least three hours during first flush and peak flow.
- Field calibrate each sampler for water level and velocity readings.
- Program each sampler to fill individual 1-gallon glass collection vessels one at a time (i.e., sample aliquots are collected in each 1-gallon vessel until it is full).
- Make sure that the sampler is above any high water level within the pipe or in a ground surface installation.
- Place the intake tubing with at least 2 inches of depth or greater for the intake. Use an anchor system or anchors to secure the tubing.
- All work requiring confined space entry will be performed by subcontractors with the necessary training.
- The glass collection vessels, screen, suction line, and pump tube will be decontaminated prior to installation. It is not anticipated that screens and intakes tubes will be removed for cleaning between sampling events. The sampler will be programmed to purge the intake tubes and silicon pump tubing several times before and after each stormwater sample is collected. Inspect tubing from the ground surface before each event. Inspect the downhole components before the start of each sampling season. If algae is growing in the intake tube, debris is blocking the tube, or any other gross contamination issues may exist, contaminated screens and intake tubes will be replaced with decontaminated screens and intake tubes decontaminated or replaced.

Collection of Samples

- Record weather conditions at the time of sampling and last known rain fall event(s). Record and describe site conditions upon arrival and during sampling on the attached site-specific sampling form.
- The AV flow meter will measure and record total flow throughout the duration of the sampling event.
- Collect samples using the "Clean Hands/Dirty Hands" sampling technique. Operations involving direct contact with the sample bottle, sample bottle lid, sample suction tubing, and the transfer of the sample from the sample collection device to the sample bottle are handled by "clean hands". "Dirty hands" is responsible for preparation of the sampler (except the sample container itself), operation of any machinery, and for all activities that do not involve handling items that have direct contact with the sample.
- Cap the glass collection vessels and remove from the sampler.
- Submit samples to the laboratory under chain-of-custody protocols for compositing, filtration (as necessary), and analysis.

Stormwater Sampling Field Form

Client:		Project Number:	
Project:		Link to Project Plan:	
Laboratory:		Date:	
Sampler:		Time In:	
Sampler:		Time Out:	

WEATHER CONDITIONS (on arrival and as conditions change; describe rainfall, runoff patterns, etc.)

Time:		Time:	
Time:		Time:	
Time:		Time:	
Time:		Time:	

SAMPLING DATA

BASIN/OUTFALL ID:		**BASIN/OUTFALL ID:**		**BASIN/OUTFALL ID:**	
Grab or Composite Sampling:		Grab or Composite Sampling:		Grab or Composite Sampling:	
Grab Sampling Method (peristaltic pump/swing sampler/directly at outfall)		Grab Sampling Method (peristaltic pump/swing sampler/directly at outfall)		Grab Sampling Method (peristaltic pump/swing sampler/directly at outfall)	
Sampler Program (composite only):		Sampler Program (composite only):		Sampler Program (composite only):	
Sample ID:		Sample ID:		Sample ID:	
Sample Time:		Sample Time:		Sample Time:	
# Containers/Type	Preservative	# Containers/Type	Preservative	# Containers/Type	Preservative

COMMENTS

Table A-1 – Target Reporting Limits
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Analyte	Units	MDL	MRL	JSCS
Total Suspended Solids (TSS) by method SM2540 D				
TSS	mg/L	1	1	--
Metals (EPA Method 1632)				
Arsenic	ug/L	0.003	0.02	0.045
Polycyclic Aromatic Hydrocarbons (EPA Method 8270-SIM)				
Acenaphthene	ug/L	0.36	3.4	0.2
Acenaphthylene	ug/L	0.37	3.4	0.2
Anthracene	ug/L	0.29	3.4	0.2
Benz(a)anthracene	ug/L	0.34	3.4	0.018
Benzo(a)pyrene	ug/L	0.41	3.4	0.018
Benzo(b)fluoranthene	ug/L	0.25	3.4	0.018
Benzo(g,h,i)perylene	ug/L	0.36	3.4	0.2
Benzo(k)fluoranthene	ug/L	0.41	3.4	0.018
Chrysene	ug/L	0.65	3.4	0.018
Dibenz(a,h)anthracene	ug/L	0.45	3.4	0.018
Fluoranthene	ug/L	0.46	3.4	0.2
Fluorene	ug/L	0.42	3.4	0.2
Indeno(1,2,3-cd)pyrene	ug/L	0.44	3.4	0.018
Naphthalene	ug/L	0.71	3.4	0.2

Notes:
1. -- = Not available or not applicable.
2. MDL = Method detection limit (MDL).
3. MRL = Method reporting limit (MRL).
4. JSCS = Screening levels from Portland Harbor Joint Source Control Strategy – Final (Table 3-1 Updated July 16, 2007). December 2005